

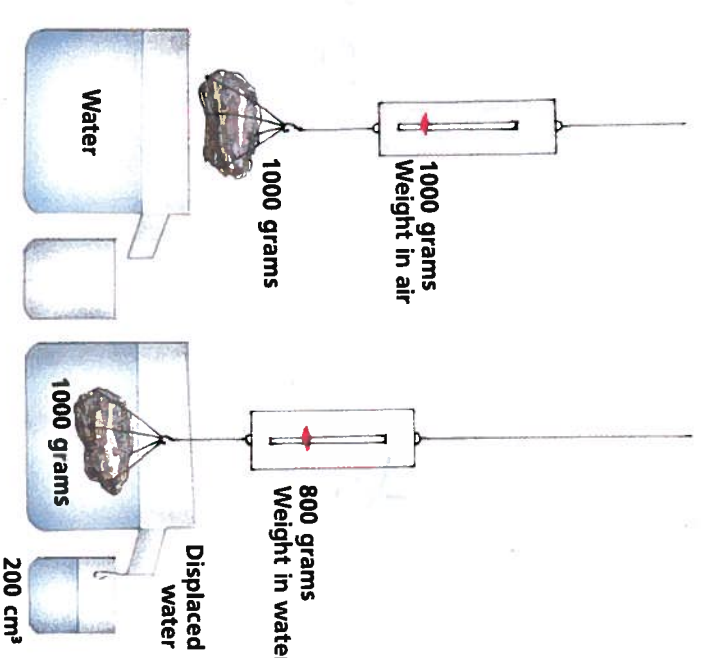
13-5 What is buoyancy?

Objective ► Explain Archimedes' principle in terms of buoyancy and displacement.

TechTerm

- **buoyancy** (BOI-uhn-see): upward force exerted by a gas or liquid

Archimedes' Principle Archimedes observed water rising when he stepped into a tub. He also noticed that his body seemed to feel lighter in water. Archimedes thought that the rising of the water in the tub and his feeling of weight loss must be related. He found that the loss of weight of an object in water is equal to the weight of the displaced water. This is called Archimedes' principle (PRIN-suh-puhl).



► **State:** What does Archimedes' principle state?

Buoyancy When an object is placed in water, it seems to weigh less. The water exerts an upward force on the object. The upward force decreases

the weight, or the downward pull of gravity, of the object. This upward force is called **buoyancy** (BOI-uhn-see). Buoyancy is the upward force exerted on an object by a gas or a liquid.

You can observe buoyancy in action when you watch a person or a boat float on the surface of water. You can experience buoyancy yourself by standing in the shallow end of a swimming pool and lifting your leg. Your leg will seem very light. Your leg feels light because the buoyant force of the water is helping to hold up your leg.

► **Define:** What is buoyancy?

Buoyancy and Archimedes' Principle Archimedes' principle states that the amount of weight lost by an object in water is equal to the weight of the water that the object displaces. Buoyancy also is related to displacement. The buoyant, or upward, force on an object is equal to the weight of the water that the object displaces. If a rock weighing 4 N displaces an amount of water weighing 1 N, the buoyant force on the rock is 1 N. The rock's weight in the water is 4 N – 1 N, or 3 N.

► **Apply:** If a buoyant force of 6 N acts on a block placed in water, what is the weight of the water that the block displaces?

Floating Buoyancy explains why an object sinks or floats. Suppose that an object displaces enough water so that the weight of the displaced water is equal to its own weight. The buoyant force on the object is equal to the object's weight. As a result, the weight of the object in water is zero. The object floats. An object also floats if it displaces a weight of water greater than its own weight. When a ship is placed in water, the weight of the water it displaces is equal to or greater than the ship's weight. That is why big, heavy ships can float.

► **Recognize:** When will an object float in water?

LESSON SUMMARY

- Archimedes' principle states that the loss of weight of an object in water is equal to the weight of water the object displaces.
- Buoyancy is the upward force exerted by a gas or a liquid.
- Buoyancy helps hold objects in water or in the air.
- The buoyant force on an object is equal to the weight of the water that the object displaces.
- An object floats if the weight of the water it displaces is equal to or greater than its own weight.

CHECK Complete the following.

1. Buoyancy is the _____ force exerted by a gas or a liquid.
2. The buoyant force on an object is equal to the weight of the water it _____.
3. When the buoyant force on a object is equal to or greater than its weight, the object _____.

4. Buoyancy decreases the downward pull of _____ on an object.
5. A ship floats because the weight of water it displaces is equal to or greater than its own _____.

APPLY Complete the following.

6. a. A wood block is 10 cm long, 5 cm high, and 3 cm wide. How much water will the block displace? b. If the density of water is 1 g/cm³, what will be the buoyant force on the block?
7. How are displacement and buoyant force related?

Health and Safety Tip

Always wear a life jacket if you go sailing or canoeing. If you fall into the water, the air in the jacket will decrease your density and help you to float, even if you cannot swim. Visit a local swimming pool. Ask the swimming instructor to describe how people are taught to float.

LEISURE ACTIVITY

BALLOONING

A hot-air balloon can float because the hot air in the balloon is less dense than the surrounding air. People have risen to very high altitudes in balloons. In 1978, a balloonist crossed the Atlantic Ocean for the first time in history.

Balloonning is a sport that involves competition among balloonists. Some or the events in balloon competitions include long-distance races and spot-landing matches. In a long-distance race, the winning balloon is the one that travels the farthest and stays in the air the longest. In a spot-landing match, a prize is given to the balloonist who is able to land closest to a certain point.

In the United States, balloon pilots must be licensed by the Federal Aviation Agency. Competitions are governed by the National Aeronautic Association (NAA) and the Balloon Federation of America.

